



Case Report

Cobra bite wound infection caused by *Shewanella algae*

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SUMMARY

Shewanella wound infections after snake bites are rare. We report the case of a *Shewanella algae* wound infection associated with a cobra bite in a 27-year-old woman. The isolate was confirmed by sequencing of the 16S ribosomal DNA gene. This case expands the reported spectrum of infection caused by *S. algae* and raises the possibility that *S. algae* could be a causative pathogen in wound infections resulting from snake bites.

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1. Introduction

Shewanella species are facultative anaerobic, non-fermentative Gram-negative bacilli that are often associated with soft tissue infections, bacteremia, hepatobiliary infections, and otitis media.¹ At present, four species of *Shewanella* have been reported to cause human infection: *Shewanella putrefaciens*, *Shewanella algae*, *Shewanella haliotis*, and *Shewanella xiamenensis*.^{1,2} *Shewanella* wound infections following snake bites are rarely reported, and in most cases the isolates have been identified by conventional biochemical methods.³ To our knowledge, no other case of snake bite wound infection caused by *S. algae* has been reported thus far. Herein, we report a case of *S. algae* wound infection following a cobra bite. The isolate was confirmed at the species level using 16S ribosomal DNA sequencing.

2. Case report

A 27-year-old woman presented to the emergency department 5 h after being bitten by a cobra (*Naja atra*). The bite had resulted in two puncture wounds on the dorsal surface of her left foot. The patient was harvesting pears when the bite occurred. At initial presentation, the patient was in pain and had swelling in the left foot with extension to the lower leg. She denied weakness or other neurological symptoms.

Her vital signs revealed a heart rate of 112 beats/min, blood pressure of 125/79 mmHg, respiratory rate of 18 breaths/min, and temperature of 37 °C. Examination of the wounded extremity showed erythema and edema, with tenderness throughout the foot extending up to the lower leg. Blisters and skin necrosis developed at the site of the snake bite.

Laboratory studies showed a white blood cell count of 15×10^9 cells/l with 87.0% segmented neutrophils, hematocrit of 30.1%, and platelet count of 241×10^9 platelets/l. The serum creatinine kinase level was found to be elevated at 154 U/l (upper limit of normal, 120 U/l). The local symptoms progressed rapidly over the next 2 days. She underwent surgical debridement of necrotic fascia and intravenous ampicillin/sulbactam was started. Culture of the specimen obtained during the operation yielded Gram-negative, non-fermentative, oxidase-positive bacilli. The isolate showed a

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muroid colony with β -hemolysis on blood agar plate after 48 h of incubation and H_2S production on triple sugar iron agar. It was identified as a *Shewanella* species using conventional biochemical methods. The organism was susceptible to ampicillin–sulbactam, ceftriaxone, cefepime, and imipenem, but was resistant to ceftazolin and colistin. Results of blood cultures were negative. The patient subsequently underwent debridement 12 days after the first operation. The wound condition improved slowly after debridement and a skin graft was performed. The patient was discharged from the hospital on day 21 after the snake bite injury. Some contracture of the skin graft developed on the left leg.

The isolate was further confirmed to the species level by 16S ribosomal DNA sequencing.² The primers used for amplification of the 16S ribosomal DNA gene were B27F (5'-AGAGTTT-GATCCTGGCTCAG-3') and U1492R (5'-GGTTACCTTGTACGACTT-3'). The amplification products obtained by PCR were sequenced, and the sequences obtained (1265 bp) were compared to known 16S ribosomal DNA sequences in the GenBank database of the National Center for Biotechnology Information using the BLASTN algorithm (<http://www.ncbi.nlm.nih.gov/blast>). The closest match was obtained with *S. algae* (GenBank accession number **HM016087.1**; maximal score 2326, E value 0.0, and maximal identity 99% (1263/1265)).

3. Discussion

Wound infection after a snake bite is an uncommon but potentially life- and limb-threatening disease.³ Infections secondary to snake bites often present with soft tissue abscess and necrosis.³ There is a wide spectrum of causative organisms associated with snake bite-related wound infections, and polymicrobial infections are common.³ The bacteriological characteristics vary among different snake genera and geographic regions. Currently, more than 20 species of bacteria have been isolated from wounds caused by snake bites, and *Enterobacteriaceae* are the most important causative agents.³ There are few reports of wound infections caused by *Shewanella* after a snake bite, particularly from South Asia.³

In Asia, *Shewanella* has been reported to colonize the oral cavity of the cobra.³ Circumstantial evidence suggests that the bacteria causing snake bite wound infections are derived from the indigenous oral flora of the snake, which may reflect the fecal flora of the eaten prey.³ Moreover, the affinity of *Shewanella* for necrotic tissue has been reported, and necrosis is an important feature of cobra bites.³ An animal study has also revealed that soft tissue affected by snake venom is more prone to bacterial infection.⁴ Thus, *Shewanella* tends to be involved in infections of the wound after a cobra bite.

S. algae and *S. putrefaciens* are the two most common *Shewanella* species known to cause human infections.⁵ However, species identification can be difficult. Although *S. algae* can be distinguished from *S. putrefaciens* on the basis of growth at 42 °C and in 6% NaCl and nitrite reduction, many closely related *Shewanella*

species cannot be differentiated by biochemical methods.⁵ Moreover, many automated systems only include *S. putrefaciens* in the database.¹ It is reported that more than 80% of clinical isolates previously identified as *S. putrefaciens* were actually *S. algae*.⁵ Molecular characterization is capable of distinguishing *S. algae* from closely related species of the *Shewanella* genus and providing correct speciation.¹ By performing 16S ribosomal DNA sequencing, we have been able to identify more *Shewanella* species, such as *S. haliotis* and *S. xiamenensis*, as pathogenic organisms.^{1,2} In patients suffering from *Shewanella* infections, the results from conventional methods should be analyzed critically.

Although systemic administration of antibiotic therapy is controversial for typical snake bites, it should be considered in cases presenting with local infection. Penicillin or ceftazolin are commonly prescribed empirical therapy for snake bite wound infections.³ Nevertheless, this approach is probably not optimal for the treatment of *Shewanella* infections. *Shewanella* exhibits a natural resistance to penicillin and ceftazolin.² Resistance to colistin is common among *S. algae* isolates.⁵ It is usually susceptible to broad-spectrum beta-lactam antibiotics; of these agents, piperacillin–tazobactam, carbapenems, and third- and fourth-generation cephalosporins are the most active against *Shewanella*.² However, because some cases of emerging resistance to piperacillin–tazobactam and imipenem during treatment have been described, treatment failure should alert the clinician to the possibility of emerging resistance.² Definitive treatment should be based on antimicrobial susceptibility combined with adequate surgical debridement.

In conclusion, *S. algae* should be suspected in cases of wound infection following a cobra bite. Clinicians and microbiologists should be aware of the potential for misidentification of *Shewanella* species by automated systems. Identification of this unusual organism from the surgical specimens of patients with a snake bite should trigger further clinical and laboratory evaluation. If shewanellosis is suspected, prompt and appropriate antibiotic treatment is required, avoiding penicillin and first-generation cephalosporins.

Conflict of interest: The authors declare that no competing interests exist. None of the authors have any financial relationships with other people or organizations that could inappropriately influence (bias) their work.

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